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# Cold atoms quantum simulation of the Sachdev-Ye-Kitaev model

The Sachdev-Ye-Kitaev (SYK) model has emerged as a prototype of holographic quantum matter: it has no quasi-particles, displays maximal chaos, and shares salient features with Jackiw-Teitelboim gravity. At the same time, the SYK model sits at the cutting edge of current quantum simulation of strongly-correlated systems, as it requires fully-connected, random, and independently distributed two-body interactions, while allowing only for negligible single-body terms. As a result, scalable laboratory implementations are still lacking.

In this talk, I will present how cold fermionic atoms in a high-finesse cavity can scalably realize the SYK model. I will present numerical benchmark calculations of the effective model, derived from first principles. I will discuss an unexpected universality in the equal-time correlators that could be a first experimental indicator. Finally, I will present a first concrete step towards an experimental implementation, the cavity QED quantum simulation of a disordered spin system, performed by the EPFL group.

This body of work opens a path to experimentally investigating holographic quantum matter in the laboratory, and it yields new theoretical insights such as the relevance of the disorder distribution.

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